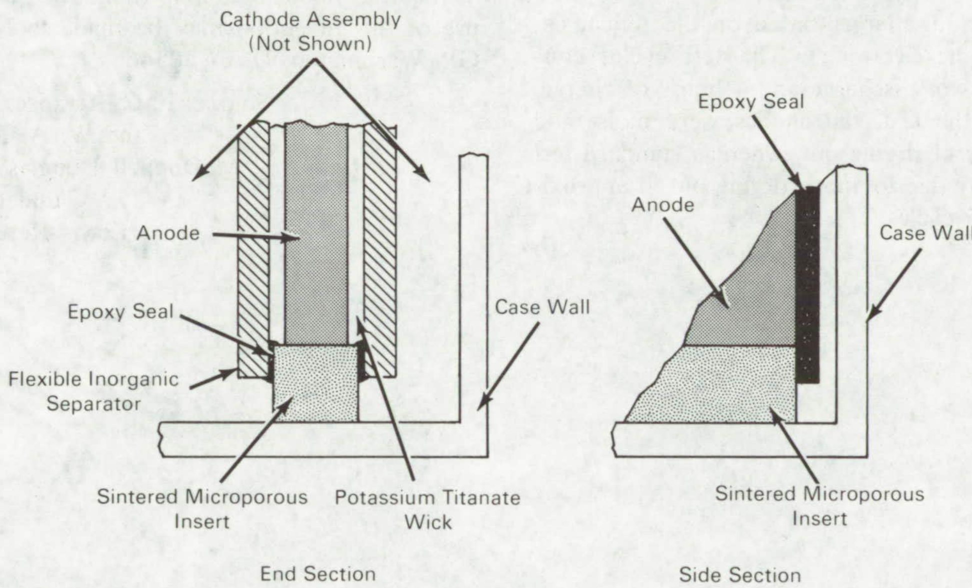
NASA TECH BRIEF

Improved Anode Design for Metal-Oxygen Cells



The problem:

A major problem which limits the life of metal-oxygen secondary battery cells is the drying out of the anode (loss of electrolyte from the anode) during charge–discharge cycling. The electrolyte is held in the cell separators and prevents the oxygen from coming into direct contact with the zinc anode. However, during discharge, the zinc anode expands and thereby forces some of the electrolyte out of the separators. This electrolyte falls to the bottom of the cathode compartment and there is no way for it to return to the anode. As the anode tends to become progressively drier after each cycle, the cell loses capacity until it is unable to deliver the power required by its duty cycle and fails. Various methods for minimizing this problem have been tried, such as placing thick layers of absorbent material inside or outside of the anode compartment and providing storage pockets inside the anode compartment to hold excess electrolyte. These methods have not been entirely successful although some increase in cycle life can be obtained in this manner.

The solution:

A method has been developed for returning electrolyte to the anode compartment which has been found to be very satisfactory in preventing or minimizing anode drying, and thereby substantially increases the cycle life of zinc–oxygen cells.

How it's done:

The method of returning electrolyte to the anode compartment is illustrated by the sketch which shows

(continued overleaf)

sectional views of a zinc anode assembly and cathode compartment. A ceramic microporous insert (MPI) is placed in the bottom of the anode, and is cemented in place with epoxy cement. A layer of wicking material (potassium titanate) is placed on each of the flat surfaces of the anode. These wicks are also in contact with the MPI. With this arrangement, electrolyte which is forced out of the separator and falls to the bottom of the cathode compartment during discharge is taken up by the porous MPI and is returned up the anode by action of the wicking material.

The MPI contains electrolyte and acts in the same manner as the separator to protect the anode from contact with the oxygen. The zinc–oxygen cells containing MPI inserts and wicks have been tested for as many as 243 charge-discharge cycles at about 25 percent depth of discharge (based on theoretical capacity of the zinc electrode). The test cycles consisted of 2 hours of discharge and 4 hours of charge. At the end of the test, the anodes were moist and showed no signs of drying out, whereas standard test cells lost capacity due to anode drying out in approximately 10 to 75 cycles.

Notes:

1. The MPI can be made of any material which is suitably porous and resistant to the electrolyte. The design can be used with organic separators as well as inorganic and with other high energy density cells such as silver–zinc and silver–cadmium.
2. No further documentation is available. Technical questions may be directed to:

   Technology Utilization Officer
   Lewis Research Center
   21000 Brookpark Road
   Cleveland, Ohio 44135
   Reference: B69-10318

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D. C. 20546.

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